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A New Anuran from the Middle Miocene of Nevada

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ABSTRACT: A new fossil Anuran, *Miopelodytes gilmorei*, is described as a new genus and species. The form is most closely related to *Pelodytes punctatus* and *P. caucasicus* of southern Europe and southwestern Asia. The family PELODYTIDAE Cope is revived to receive the two genera, excluding other forms placed in it by Cope.

A FOSSIL toad preserved in a shale slab, and representing a new genus, has been placed in my hands for study by Dr. Charles W. Gilmore of the United States National Museum. The specimen is remarkable not only because so many significant skeletal characters are discernible (the specimen prior to collection seemingly having been preserved perfectly), but also because there is unmistakable imprint of the skin so that in a measure the character of the skin and the body outline is indicated. Moreover, it is the second oldest Anuran discovered in the Western Hemisphere, and is the only extinct member of the family PELODYTIDAE known and its only representative in the Western Hemisphere.

With the cleaving of the slab to expose the enclosed animal, the soft fossilized bone has crumbled in many places, leaving only a powdery remains. However, the imprint of the bones is clear in many places and serves to delineate the original features. Nevertheless, many important characters of the skull and the characteristics of the centra of the vertebrae cannot be determined.

Miopelodytes gen. nov.

Characterized by the absence of free ribs; eight presacral vertebrae; sacral vertebrae with greatly widened diapophyses, presumably free from coccyx; epiphyses of long bones cartilagenous; coccyx apparently composed of more than a single element; proximal tarsals fused into a single bone; prehallux absent.

Miopelodytes gilmorei sp. nov.*

Type specimen. U. S. N. M., No. 12356. Consists of entire skeleton preserved in shale slab (portion of right arm missing). Collected by W. L. Sheeler, and donated to the Museum by R. M. Catlin.

Type locality. R. 55 E., T. 34 N. Near the town of Elko, Nevada.

Horizon. Elko Shales, Middle Miocene.

Description. The animal lies on its back, and the ventral bones of the skull and the ventral surfaces of most of the elements are wanting at the present time. It is probable that they may have been attached to the other half of the slab after cleaving. Whether or not this part is in existence I do not know.

The head-body length of the fossil is 51 mm. from the premaxillae to the end of the ischium. The hind limb is about 85 mm. in total length. These measurements represent rather closely the actual length.

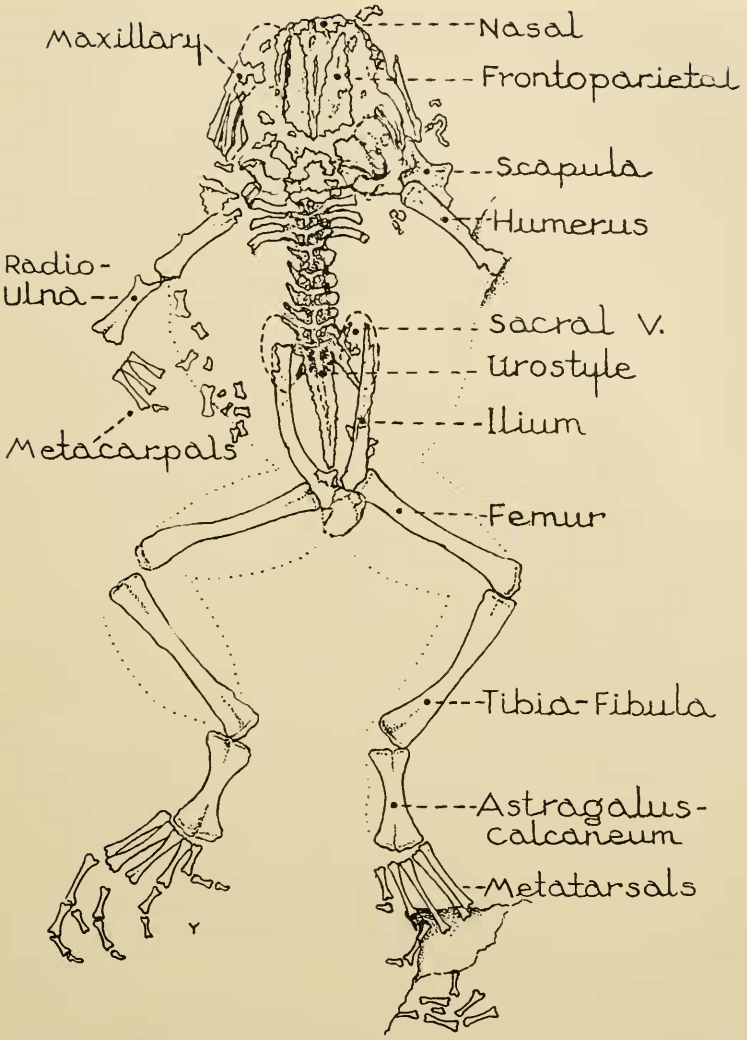
Skull. All the elements of the cranium are fragmentary, and the parts remaining have the consistency of a greasy powder. All the ventral skull bones apparently are absent and the maxillae and premaxillae are represented only by their more dorsal portions. Thus there is no evidence of teeth, although it is highly probable that they were originally present. There is a trace of the posterior part of the right mandible showing a posterior flexure. The outlines of the frontoparietals show them as elongate triangular bones, separated medially by a narrow fontanelle. Judging from the position in which they lie, there appears to have been a groove or depression on the dorsal surface of the head. Along the anterior tip of the right frontoparietal is a tiny fragment bearing two conical teeth lying loose. I believe this to be a fragment of a prevomer (although it may be a broken fragment of one of the upper jaw bones). The imprint of the posterior part of the skull presents a very uneven surface, but no significant details can be ascertained.†

Pectoral girdle and limb. The scapula of the left side is nearly intact. It is seen from the ventral surface, and is of typical shape. A minute fragment of the suprascapula adjoins it at the outer end. The characters of the clavicle, coracoid, and sternal elements cannot be determined.

The humerus is of ordinary shape articulating with the rounded socket of the radio-ulna. The distal end of the latter element is clearly defined. Between the radio-ulna and metacarpals are de-

* The species is named for Dr. Charles W. Gilmore of the United States National Museum.

† If the powdery remnants of the bone were to be removed from the matrix and a cast made, the characters of the dorsal skull surface could easily be obtained.



TEXT FIG. 1. *Miopelodytes gilmorei* sp. nov. U. S. N. M. No. 12356. Middle Miocene, Elko shales. Near Elko, Nev. An outline of the bones.

pressions suggesting the presence of at least four carpals. These apparently were cartilage as such fragments as remain are infiltrated with a black crystalline mineral like that found in the epiphyses of the longer bones. Three outer metacarpals remain, as well as a dim imprint which may represent the first metacarpal. The phalanges are displaced on the right hand, while the whole lower arm is missing on the left side.

Pelvic girdle and limb. The pelvic girdle is represented by the ilia and at least a part of the pubo-ischial complex. The two latter elements cannot be differentiated. However, there is a slight notch apparent suggesting that the pubis was cartilage (or possibly wanting). The ilia curve slightly and are attached nearly the length of the elongate sacral diapophyses. The femora are slightly curved and traces of the cartilagenous epiphyses are evident, infiltrated with a black crystalline mineral. The double character of the tibia-fibula is evident. The proximal tarsals are fused together throughout their length, greatly narrowed medially, and widened at each end where the bifid character is well defined. The toes are rather long. The formula of the phalanges (right foot) is 2-2-3-4-?; the terminal phalanges are cylindrical and taper to an oval pointed tip. I find no trace whatever of distal tarsals or of a prehallux.

Vertebrae. The fragmentary vertebrae are nine in number,* eight preceding the sacral vertebra, which has greatly dilated diapophyses that present a curving outer edge (save for some fragments these diapophyses are represented by a rather clear imprint on the matrix). The processes of the second to fourth vertebrae are about the same length, the second curved slightly forward, the fourth curving back, slightly; the succeeding vertebrae have very short slender processes directed obliquely forward. I cannot determine positively whether the urostyle is fused to, or articulated with the sacrum, although it appears to articulate. There is evidence that there is a partial separation of the anterior part of the urostyle as if it were composed of a more or less separate vertebra and a urostyle.

Measurements in mm. Estimated length of head-body, 57; actual length of bones in situ, 51; length of skull, 17; width of skull (perhaps somewhat distorted), 23; humerus, 12.5; radio-ulna, 9.5; femur, 19; tibia-fibula, 19.2; astragulo-calcaneum, 10.5; metatarsals in order, 4, 5.8, 7.8, 8, 7.2; length of fourth toe, 21.4; third toe, 16; length of ilium and ischium combined, estimated, 20.5; length of urostyle to posterior end of sacral vertebra, 13; width of third vertebra, 10.8.

Skin. The outline of the body is evident in the darkened area, visible in the photograph, suggesting that the animal was squat and toadlike. From the width of the femoral and tibial regions it is probable that this has been flattened and widened by pressure. That the skin was irregularly granulate or tuberculate is evidenced by

* The first (atlas) vertebra is fused with the second.

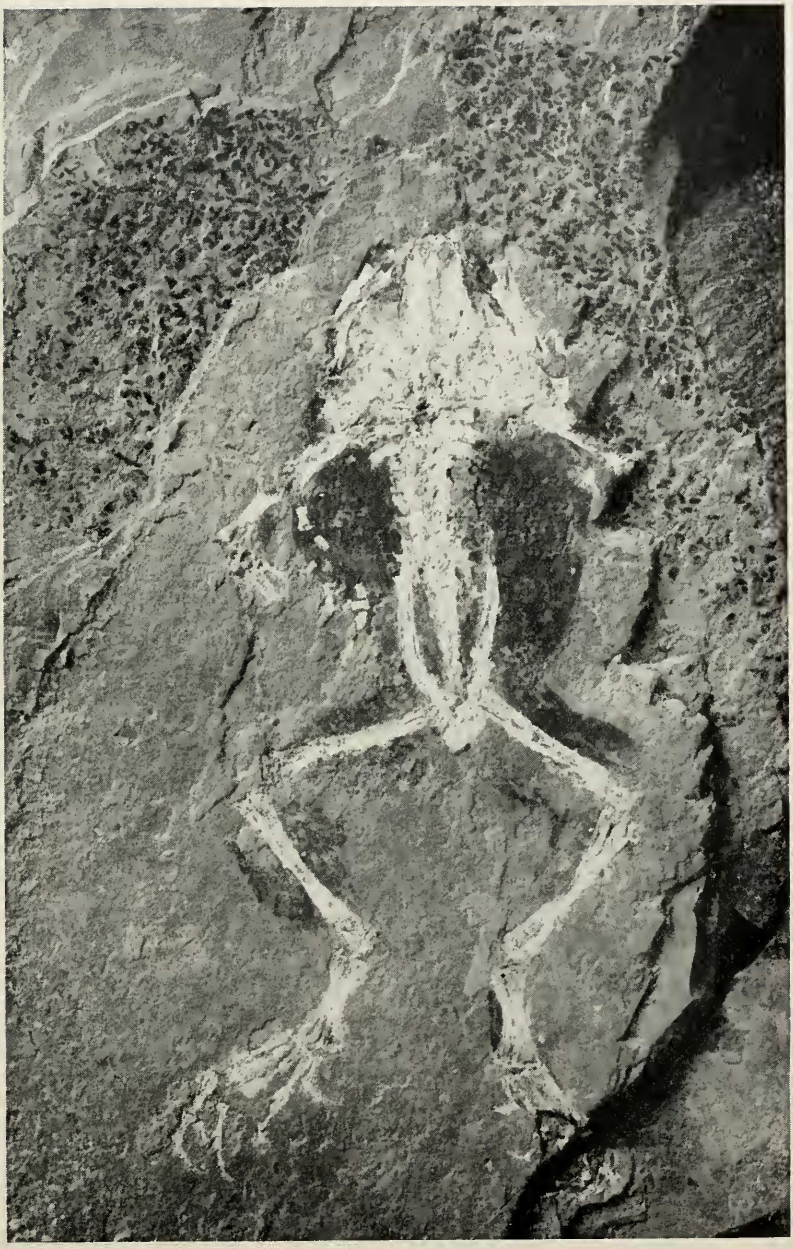


PLATE I. *Miopelodytes gilmorei* sp. nov. U. S. N. M. No. 12356. Type. Middle Miocene, Elko shales, Elko, Nev. (Photo by courtesy of the United States National Museum.)

irregularities on the surface clearly distinguishable to the naked eye. This skin material forms an extremely thin layer which is easily dislodged.

Remarks. Since the described animal appears to be most closely related to a living European genus *Pelodytes* it seems pertinent to review the classification of this and other genera associated with it. Nicholls and Noble have revised the classification of the frogs primarily on the basis of the salient characters of the vertebrae. The arrangement of Noble (1931) divides the Anura (Salientia) into five suborders.

I. AMPHICOELA (Amphicoelous vertebrae).
II. OPISTHOCOELA (Opisthocoelous vertebrae; free ribs in larvae or adults).
III. ANOMOCOELA (Vertebrae variable; sacral vertebrae procoelous, fused to coccyx or free with either single or double condyle; presacral vertebrae procoelous or with free intervertebral disks).
IV. PROCOELA (Procoelous vertebrae; double condyle on coccyx—rarely fused).
V. DIPLASIOCOELA (Sacral vertebrae centrum convex anteriorly, preceded by the eighth vertebra, which is biconcave and preceded by seven procoelous vertebrae).

We are especially concerned here with the presumedly more primitive groups associated by Noble with the first three suborders.

Order Salientia
  Suborder I. Amphicoela
    Family Liopelmidae
  Suborder II. Opisthocoela
    Family Discoglossidae
    Family Pipidae
      Subfamily Xenopinae
      Subfamily Pipinae
  Suborder III. Anomocoela
    Family Pelobatidae
      Subfamily Megophryinae
      Subfamily Pelobatinae
      Subfamily Sooglossinae

Our concern is chiefly with the suborder III, Anomocoela. In it is placed the single family PELOBATIDAE (which equals the families SCAPHIOPODIDAE and PELOBATIDAE of recent authors and the PELODYTIDAE of Cope).

This is divided into three subfamilies:

I. *Megophryinae*, Pelobatids with free intervertebral disks or the free intervertebral disks more or less exposed, including

Megophrys [= *Megalophrys* and *Leptobrachium*], *Nesobia, Scutiger, Aelurophryne, Ophryophryne, Leptobrachella;* Indian, South Asia and the Indo-Australian region, the Philippines and Natuna Islands (not reaching New Guinea).

II. *Pelobatinae.* "Pelobatids with presacral vertebrae uniformly procoelous, sacrum fused to the coccyx except in *Pelodytes* which has a single condyle" (sic, *in errore*). This includes *Pelobates, Scaphiopus* and *Pelodytes.* North America to Central America, Europe and Asia.

III. *Sooglossinae.* Pelobatids with a free coccyx, a horizontal pupil and a ranid type of thigh musculature. Seychelles Islands, Indian Ocean.

The placing of the genus *Pelodytes* in the family *Pelobatidae,* and more especially in the subfamily *Pelobatinae,* is without regard for numerous very important characters. As is seen from the definition of the suborder, it is something of a catch-all.

The genera *Scaphiopus* and *Pelobates* agree in the fusion of the sacral vertebra and the coccyx, in the more strongly roofed skull, with the pitted "stegocephalian type" of bone surface appearing frequently, the separate astragalus and calcaneum, the presence of a large bony prehallux forming a spade, and their general toadlike appearance; the first two vertebrae are not fused.

On the other hand, *Pelodytes* has a slender, fragile, reduced type of skull, with smooth bones, the palatine bone wanting, astragalus and calcaneum fused, and a minute cartilagenous prehallux, not forming a spade. The coccyx does not fuse with the sacral vertebrae, but articulates by a double condyle; first two vertebrae fused. The habitus is slender, froglike.

The fossil history of the group here associated in the PELOBATIDAE (of Noble) is very fragmentary. However, at least representatives of three groups are known. Noble (1924) described a spade-foot toad from the Oligocene of Mongolia, *Macropelobates osborni* (new genus and species), as follows: "Undoubtedly a pelobatid in that it exhibits the following characters: anomocoelous, with coccyx not ankylosed to sacrum; coccyx with a single condyle; teeth present on upper jaw; coracoids suggesting an arciferal condition; an enormous prehallux (spade); epiphyses absent (cartilagenous); a bony incrustation on the frontoparietal, nasal, and squamosal." Thus it appears that this, the oldest known form, bears a close resemblance to *Pelobates.* The free coccyx with single condyle is significant, but this is occasionally present in some species of *Pelobates.* The astragalus and calcaneum are separate and there is no approach to the characters of *Pelodytes* or *Miopelodytes.*

Parker (1929) has described the genus *Eopelobates* from the Miocene beds of Roth, near Bonn, Germany. While he does not definitely refer it to the family PELOBATIDAE he suggests that a relationship exists, pointing to several characters that link it with the pelobatids and offering none that disclaim the relationship save the absence of a prehallux, and the shorter proximal phalanges. Here the astragalus and calcaneum are entirely distinct.

I have described (Taylor, 1936, 1939) two fossil species from the Pliocene, which have been referred to the genus *Scaphiopus*. There is nothing in these forms to throw light on the relationships of the American forms that is not evident in living forms.

The complete fusion of the radius and ulna, and of the tibia and fibula constitute probably one of the oldest Anuran characters. It very probably appeared in some caudate ancestor. These elements have every appearance of being fused in the caudate form of uncertain relationship known as *Pelion lyelli* Wyman (1858, and Moodie 1916, Pl. 24, fig. 1) from the coal measures of Linton, Ohio. So far as I know, no Anuran has brought about the separation of these elements. I conceive that the fusion of the astragalus and calcaneum was a continuation of the ancient fusion of the more proximal parts of the limbs and has been retained today only in *Pelodytes*. I would expect to find this condition present in the earliest definitive Anura and later ones prior to the assumption of the leaping habit. I believe that the separation of the astragalus and calcaneum was a later development, brought about by the leaping habit.

Whether the oldest known frog *Eobatrachus agilis* Marsh from the Jurassic had these elements fused has not been determined. The fact that Moodie (1912) placed the form in the BUFONIDAE is not significant for, on the basis of his material, it might just as easily have been placed in any one of several other families.

Cope's Family PELODYTIDAE included two genera, *Leptobrachium* and *Pelodytes*. He defined the family as follows: "Vertebrae procoelian; no ribs or diapopyses of coccyx. Sacrum united with the coccyx by condyle, its diapophyses thin and largely dilated. Xiphisternum an osseous style, with terminal disk. External metatarsi bound together." *

His concept of the family was again modified, and later† he includes *Xenophrys* and *Batrachopsis* in the family.

* Cope, Journ. Acad. Nat. Sci. Phila., (2) VI, 1866, p. 80.
† Cope, Bull. U. S. Nat. Mus., 34, 1889, p. 296.

The proposed disposition of the two genera *Pelodytes* and *Miopelodytes* is as follows:

Family PELODYTIDAE Cope, 1866 (excluding all genera save *Pelodytes*).

Pelodytes Fitzinger (1838).

Miopelodytes Taylor (1941).

The following characters should be included as family characters: Astragulus and calcaneum fused; two anterior vertebrae fused.

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